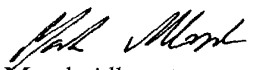
STATEMENT TO COMPUTER DISK AND SEQUENCE LISTING

The content of the incorporated sequence listing information recorded in computer readable form is identical to the herein incorporated written sequence listing and no new matter has been included. A written sequence listing of 65 sequences is included as well as a computer disk labeled "Corrected Sequence Listing" for application entitled "Light-driven energy generation using proteorhodopsin" by Edward F. DeLong and Oded Beja" containing files "MBA101-SEQLIST_CORR.prj", dated "8/4/01" with 171,574 bytes, which is the PatentIn project file generated using PatentIn Version 3.0 software provided by the USPTO, and "MBA101-SEQLIST_CORR.txt", dated "08/04/01" with 314,695 bytes, which is the generated sequence listing from the PatentIn project file MBA101-SEQLIST_CORR.prj using PatentIn Version 3.0 software, all which are herein incorporated. The information recorded in computer readable format on the incorporated computer disk labeled "Corrected Sequence Listing" containing files "MBA101-SEQLIST_CORR.prj" and "MBA101-SEQLIST_CORR.txt" are identical to the incorporated written sequence listing.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Title 18, §1001 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,



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Santa Clara, CA 95051-6670
(408) 260-7300 x15

following page that the content of the sequence listing recorded in computer readable form on the incorporated computer disk is identical to the incorporated written sequence listing.

Respectfully submitted,

Marek Alboszta
Reg. No. 39,894

Lumen
45 Cabot Avenue, Suite 110
Santa Clara, CA 95051-6670
(408) 260-7300 x15

SEQUENCE LISTING

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<302> Bacterial rhodopsin: evidence for a new type of phototrophy in the sea
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Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 6

<211> 747
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(747)
<223> Native proteorhodpsion DNA sequence from BAC clone 31A08

<300>
<301> Beja,O., Aravind,L., Koonin,E.V., Suzuki,M.T., Hadd,A., Nguyen,L.P., Jovanovich,S.B., Gates,C.M., Feldman,R.A., Spudich,J.L., Spudich,E.N. and DeLong,E.F.
<302> Bacterial rhodopsin: evidence for a new type of phototrophy in the sea
<303> Science
<304> 289
<305> 5486
<306> 1902-1906
<307> 2000-09-15
<308> AAG10475
<309> 2000-06-15
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<400> 6

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atg aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca ttt       48
Met Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr Phe
1               5                  10                  15

gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt tct       96
Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val Ser
            20                  25                  30

ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc ttt      144
Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe Phe
        35                  40                  45
```

```
gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act gta      192
Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr Val
    50                  55                  60

tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg aga      240
Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met Arg
65                  70                  75                  80

ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac att      288
Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr Ile
                85                  90                  95

gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta att      336
Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu Ile
            100                 105                 110

ctt gct gct gca act aat gtt gct gga tca tta ttt aag aaa tta cta      384
Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu Leu
        115                 120                 125

gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca gga      432
Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala Gly
    130                 135                 140

atc atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg gta      480
Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp Val
145                 150                 155                 160

tac atg att tat gaa tta tgg gct gga gaa gga aaa tct gca tgt aat      528
Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys Asn
                165                 170                 175

act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat att      576
Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr Ile
```

```
          180                 185                 190

atc atc ttt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt tac      624
Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly Tyr
        195                 200                 205

ctg atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat aac      672
Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr Asn
    210                 215                 220

ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg aat      720
Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp Asn
225                 230                 235                 240

gtt gct gtt aaa gaa tct tct aat gct                                  747
Val Ala Val Lys Glu Ser Ser Asn Ala
                245
```

<210> 7
<211> 249
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 7

```
Met Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr Phe
1               5                   10                  15

Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val Ser
            20                  25                  30

Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe Phe
```

```
        35                  40                  45

Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr Val
    50                  55                  60

Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met Arg
65                  70                  75                  80

Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr Ile
                85                  90                  95

Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu Ile
            100                 105                 110

Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu Leu
        115                 120                 125

Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala Gly
    130                 135                 140

Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp Val
145                 150                 155                 160

Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys Asn
                165                 170                 175
```

```
Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr Ile
            180                 185                 190

Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly Tyr
        195                 200                 205

Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr Asn
    210                 215                 220

Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp Asn
225                 230                 235                 240

Val Ala Val Lys Glu Ser Ser Asn Ala
                245
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<210> 8
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> proteorhodopsin variant from clone EBAC40

<400> 8

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15
```

```
ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct cta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tcg ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gag act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta ttg ata tgt gaa ttc tac tta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca aca aat gtt gct gct ggc ctg ttt aag aaa tta     384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gag gca     432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg ggt gca ttc gtt att ggg tgt tta gct tgg     480
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
```

```
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa ggc aag gct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

ata atc atc ttt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

gac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asp Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
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<210> 9
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 9

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr

1 5 10 15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

```
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asp Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 10
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS

<222> (1)..(750)
<223> proteorhodpsin variant from clone EBAC41

<400> 10

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gct act gct gct tta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Ala Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gct act aat gtt gct gga tca tta ttt aag aaa tta     384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
```

```
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga atc atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

att atc atc ttt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac ctg atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gat ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
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<210> 11
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 11

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Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Ala Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110
```

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
180 185 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 12
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from clone EBAC64

<400> 12

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt aca gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga gga gta tgg att gaa act ggt gat tcg cct act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
```

```
                85                  90                  95

att gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gcc ggc tca tta ttt aag aaa ctt      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg gca gct tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct tcg gtt caa tca gct tac aac aca atg atg gct      576
Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

atc ata gtc ttc ggt tgg gca att tat cct ata ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Ile Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt att tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
```

```
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                          750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 13
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 13

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Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80
```

```
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Ile Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220
```

```
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240


Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  14
<211>  750
<212>  DNA
<213>  Naturally occurring gamma proteobacterium

<220>
<221>  CDS
<222>  (1)..(750)
<223>  Proteorhodopsin variant from pcr clone HOT01m: GenBank# AF349978


<400>  14
atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
```

```
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tcg ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gag acc ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta ttg ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca aca aat gtt gct gct ggc ctg ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gag gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg ggt gca ttc gtt att ggg tgt tta gct tgg      480
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa ggc aag gct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190
```

```
ata atc atc ttt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 15
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 15

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45
```

```
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190
```

```
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 16
<211> 753
<212> DNA
<213> Naturally occurring gamma prtoeobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone HOT75m1: GenBank#AF349979

<400> 16

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atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15
```

```
ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt        96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt gct      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Ala
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160
```

```
tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gcc gac ctt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 17
<211> 251
<212> PRT
<213> Naturally occurring gamma prtoeobacterium

<400> 17

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15
```

```
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Ala
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
```

```
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  18
<211>  753
<212>  DNA
<213>  Naturally occurring gamma proteobacterium

<220>
<221>  CDS
<222>  (1)..(753)
```

<223> Proteorhodopsin variant from pcr clone HOT75m3; GenBank#AF349980

<400> 18

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gta ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tac atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat aca cca aca gta ttt aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
```

```
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

ggt tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta cat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg aag      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

att att gtt att gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg agt ggt gac ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 19
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 19

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110
```

```
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 20
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone HOT75m4; GenBank #AF349981

<400> 20

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
```

```
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa gtg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Val Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
```

```
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 21
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 21

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80
```

```
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Val Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220
```

```
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240


Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  22
<211>  753
<212>  DNA
<213>  Naturally occurring gamma proteobacterium

<220>
<221>  CDS
<222>  (1)..(753)
<223>  Proteorhodopsin variant from pcr clone HOT75m8: GenBank#AF349982


<400>  22
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
```

```
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca aat gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga ttg gct cct gta tgg cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg gtg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Val
            180                 185                 190
```

```
att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gcc gac ctt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 23
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 23

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15


Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30


Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45
```

```
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Val
            180                 185                 190
```

```
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 24
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB0m1: GenBank#AF349983

<400> 24

```
atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt       96
```

```
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gag act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta ttg ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca aca aat gtt gct gct ggc ctg ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gag gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Asn Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160
```

```
gta tac atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct tcg gtt caa tca gct tac aac aca atg atg gct      576
Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

atc ata gtc ttc ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt att tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
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<210> 25
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 25

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Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15
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Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Asn Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
180 185 190

Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 26
<211> 750
<212> DNA
<213> Naturally ocurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB0m2

<400> 26

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gct act aat gtt gct gct ggc ctg ttt aag aaa tta     384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125
```

```
ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg ggt gca ttc gtt att ggg tgt tta gct tgg      480
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gag ctt tgg ctt gga gaa gga aaa gct gcg tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Leu Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

aat aca gca agt cct gct gtt cag tca gct tac aac aca atg atg atg      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Met
            180                 185                 190

atc atc atc ttt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gca ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 27
<211> 250

<212> PRT
<213> Naturally ocurring gamma proteobacterium

<400> 27

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1 5 10 15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Trp Leu Gly Glu Gly Lys Ala Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Met
180 185 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 28

<211> 750
<212> DNA
<213> Naturally occuring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB20m2; GenBank #AF349985

<400> 28

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95
```

```
att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gct gct ggc ctg ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gag gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg ggt gca ttc gtt att ggg tgt tta gct tgg      480
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa ggc aag gct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

ata atc atc ttt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
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225 230 235 240

aat gtt gct gtt aaa gaa tct tct aat gct 750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 29
<211> 250
<212> PRT
<213> Naturally occuring gamma proteobacterium

<400> 29

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1 5 10 15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr

85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
180 185 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

```
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
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<210> 30
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB20m5; GenBank#AF349986

<400> 30

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt aca gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60
```

```
gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gct act aat gtt gct gga tca tta ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

caa att atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gln Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct tcg gtt caa tca gct tac aac aca atg atg gct      576
Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

atc ata gtc ttc ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
```

195 200 205

tac cta atg ggt gac ggt ggg tca gct ctt aac tta aac ctt att tat 672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

aac ctt gct gac ttt gtt aac aag att cta ctt ggt tta att ata tgg 720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Leu Gly Leu Ile Ile Trp
225 230 235 240

aat gtt gct gtt aaa gaa tct tct aat gct 750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 31
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 31

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1 5 10 15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr

50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gln Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
180 185 190

```
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Leu Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 32
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB20m12; GenBank #AF349987

<400> 32

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30
```

```
tct ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca gct aat gtt gct gga tca tta ttt aag aaa tta      384
Ile Leu Ala Ala Ala Ala Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga atc atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa tta tgg gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
```

```
                165                 170                 175

aat act gca agt cct gct gtg caa tca gcc tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

att atc atc ttt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac ttg atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 33
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 33

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
```

```
                20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Ala Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160
```

```
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                 165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 34
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB40m1; GenBank #AF349988

<400> 34

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atg ggt aaa tta tta ctg ata ata ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Ile Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt aca gct gct cta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga gga gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gcc ggc tca tta ttt aag aaa ctt     384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca     432
```

```
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg gca gct tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tat atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat aca gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

att atc gtc ttt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac ctg atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 35
<211> 250
<212> PRT

<213> Naturally occurring gamma proteobacterium

<400> 35

```
Met Gly Lys Leu Leu Leu Ile Ile Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125
```

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
180 185 190

Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 36
<211> 750

<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB40m5;p GenBank #AF349989

<400> 36

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct cta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tcg ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gag act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta ttg ata tgt gaa ttc tac tta     336
```

```
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca aca aat gtt gct gct ggc ctg ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

ttg gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gag gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg aac gct tgg ggt gca ttc gtt att ggg tgt tta gct tgg      480
Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa ggc aag gct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

ata atc atc ttt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag aat cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Asn Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240
```

```
aat gtt gct gtt aaa gaa tct tct aat gct                                  750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  37
<211>  250
<212>  PRT
<213>  Naturally occurring gamma proteobacterium

<400>  37

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15


Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30


Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45


Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60


Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80


Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95
```

```
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Ala Gly Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Asn Ala Trp Gly Ala Phe Val Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ala Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Asn Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240
```

```
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  38
<211>  750
<212>  DNA
<213>  Naturally occurring gamma proteobacterium

<220>
<221>  CDS
<222>  (1)..(750)
<223>  Proteorhodopsin variant from pcr clone MB40m12; GenBank # AF34999


<400>  38
atg ggt aaa tta tta cgg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Arg Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt aca gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60
```

```
gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tat atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga gga gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gct gga tca tta ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga atc atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

atc atc atc gtt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Val Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205
```

```
tac ctg atg ggt gac ggt gga tca gct ctt aac tta aac ctt atc tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 39
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 39

```
Met Gly Lys Leu Leu Arg Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60
```

```
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

Ile Ile Ile Val Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
```

195 200 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
210 215 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225 230 235 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 40
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB100m5; GenBank #AF349991

<400> 40
atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca 48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1 5 10 15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt 96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

```
tct ttt tgg tta gtt aca gct gct cta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga gga gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gcc ggc tca tta ttt aag aaa ctt      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga att atg gca gct tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175
```

```
aat act gca agt cct tcg gtt caa tca gct tac aac aca atg atg gct      576
Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

atc ata gtc ttc ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt att tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 41
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 41

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30
```

```
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
```

```
                165                 170                 175

Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 42
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB100m7; GenBank #AF349992

<400> 42

```
atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt      96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc     144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act     192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tac atg     240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac     288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct cta tta ata tgt gaa ttc tac tta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gct act aat gtt gcc ggc tca tta ttt aag aaa ctt     384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca     432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140
```

```
gga att atg gca gct tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tat gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct tcg gtt caa tca gct tac aac aca atg atg gct      576
Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

atc ata gtc ttc ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aac tta aac ctt att tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gct gct gtt aaa gaa tct tct aat gct                              750
Asn Ala Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 43
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 43

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                  10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
```

```
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Tyr Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ser Val Gln Ser Ala Tyr Asn Thr Met Met Ala
            180                 185                 190

Ile Ile Val Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Ala Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 44
<211> 750
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(750)
<223> Proteorhodopsin variant from pcr clone MB100m9; GenBank #AF349993

<400> 44

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atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggt ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt act gct gct tta tta gca tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tat atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65                  70                  75                  80

aga ggg gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

ata gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110
```

```
att ctt gcc gct gca act aat gtt gct gga tca tta ttt aag aaa tta      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

ctt gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga atc atg gct gca tgg cct gca ttc att att ggg tgt tta gct tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tac atg att tat gaa cta tgg gct gga gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct gct gtg caa tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

atc atc atc ttt ggt tgg gcg att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac ctt atg ggt gac ggt gga tca gca ctt aac tta aac ctt att tat      672
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
```

245 250

<210> 45
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 45

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1 5 10 15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu

```
                100                 105                 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Ile Gly Cys Leu Ala Trp
145                 150                 155                 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

Ile Ile Ile Phe Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240
```

```
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  46
<211>  750
<212>  DNA
<213>  Naturally occurring gamma proteobacterium

<220>
<221>  CDS
<222>  (1)..(750)
<223>  Proteorhodopsin variant from pcr clone MB100m10; GenBank #AF34999


<400>  46
atg ggt aaa tta tta ctg ata tta ggt agt gtt att gca ctt cct aca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

ttt gct gca ggt ggc ggt gac ctt gat gct agt gat tac act ggt gtt       96
Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

tct ttt tgg tta gtt aca gct gct cta tta gcg tct act gta ttt ttc      144
Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

ttt gtt gaa aga gat aga gtt tct gca aaa tgg aaa aca tca tta act      192
Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt ctt gtt act ggt att gct ttc tgg cat tac atg tat atg      240
Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
```

```
65                  70                  75                  80

aga gga gta tgg att gaa act ggt gat tcg cca act gta ttt aga tac      288
Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta cta aca gtt cct tta tta ata tgt gaa ttc tac tta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct gca act aat gtt gcc ggc tca tta ttt aag aaa ctt      384
Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gtt ggt tct ctt gtt atg ctt gtg ttt ggt tac atg ggt gaa gca      432
Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
    130                 135                 140

gga ata atg gcg gct tgg cct gca ttc atc gtt gga tgt tta gca tgg      480
Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Val Gly Cys Leu Ala Trp
145                 150                 155                 160

gta tat atg att tat gaa cta tgg gct ggt gaa gga aaa tct gca tgt      528
Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
                165                 170                 175

aat act gca agt cct gct gta cag tca gct tac aac aca atg atg tat      576
Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
            180                 185                 190

atc atc atc gtt ggt tgg gca att tat cct gta ggt tat ttc aca ggt      624
Ile Ile Ile Val Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
        195                 200                 205

tac cta atg ggt gac ggt gga tca gct ctt aat cta aac ctt att tat      672
```

```
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

aac ctt gct gac ttt gtt aac aag att cta ttt ggt tta att ata tgg      720
Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

aat gtt gct gtt aaa gaa tct tct aat gct                              750
Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 47
<211> 250
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 47

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Val Ile Ala Leu Pro Thr
1               5                   10                  15

Phe Ala Ala Gly Gly Gly Asp Leu Asp Ala Ser Asp Tyr Thr Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Ala Leu Leu Ala Ser Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Arg Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60
```

Val Ser Gly Leu Val Thr Gly Ile Ala Phe Trp His Tyr Met Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Glu Thr Gly Asp Ser Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Leu Ile Cys Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Ala Thr Asn Val Ala Gly Ser Leu Phe Lys Lys Leu
115 120 125

Leu Val Gly Ser Leu Val Met Leu Val Phe Gly Tyr Met Gly Glu Ala
130 135 140

Gly Ile Met Ala Ala Trp Pro Ala Phe Ile Val Gly Cys Leu Ala Trp
145 150 155 160

Val Tyr Met Ile Tyr Glu Leu Trp Ala Gly Glu Gly Lys Ser Ala Cys
165 170 175

Asn Thr Ala Ser Pro Ala Val Gln Ser Ala Tyr Asn Thr Met Met Tyr
180 185 190

Ile Ile Ile Val Gly Trp Ala Ile Tyr Pro Val Gly Tyr Phe Thr Gly
195 200 205

```
Tyr Leu Met Gly Asp Gly Gly Ser Ala Leu Asn Leu Asn Leu Ile Tyr
    210                 215                 220

Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile Trp
225                 230                 235                 240

Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 48
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PALB1; GenBank #AF349995

<400> 48

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gta ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
```

```
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tac atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat aca cca aca gta ttt aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg cta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

ggt tta gct cct gta tta cct gct ttc att ctt ggt atg gct ggt tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Leu Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta cat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gct tac aat gca atg atg aag      576
```

```
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

att att gtt att gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg agt ggt gac ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 49
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 49

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30
```

```
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Leu Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175
```

```
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 50
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PALB2; GenBank #AF349996

<400> 50
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca 48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser

```
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt      96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt     144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct gag tgg aaa act tca ctt act     192
Phe Val Glu Arg Asp Gln Val Ser Ala Glu Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg     240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat acc cca aca gta ttc aga tat     288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta     336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt     384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct     432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg     480
```

```
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 51
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 51

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Glu Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140
```

```
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 52
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>

<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PALB5; GenBank#AF349997

<400> 52

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca        48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt        96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt       144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act       192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gcc ttt tgg cat tat ctc tat atg       240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat       288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta       336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca aat gtt gct gct tca tta ttt aag aag ctt       384
```

```
Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tgg cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac cta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 53
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 53

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110
```

```
Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 54
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PalB7; GenBank #AF349999

<400> 54

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gcg ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt acg gct ggt atg tta gcg gca act gta ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tac atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat aca cca aca gta ttt aga tat      288
```

```
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gcc gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca ttg gta atg tta ggt gct gga tct gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Ser Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctc ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220
```

```
tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 55
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 55

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80
```

```
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Ser Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220
```

```
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 56
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PalB6; GenBank # AF349998

<400> 56

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atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca      48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt      96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt     144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45
```

```
ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg      240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat      288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca aat gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tgg cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg gtg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Val
            180                 185                 190
```

```
att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac cta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 57
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 57

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45
```

```
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Asn Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Trp Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Val
```

```
            180                 185                 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250


<210>  58
<211>  753
<212>  DNA
<213>  Naturally occurring gamma proteobacteria

<220>
<221>  CDS
<222>  (1)..(753)
<223>  Proteorhodopsin variant from pcr clone PalB8; GenBank #AF350000


<400>  58
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15
```

```
ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt        96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt       144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act       192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg       240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat       288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta       336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt       384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct       432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg       480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160
```

```
tta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ctt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 59
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacteria

<400> 59

```
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15
```

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
115 120 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
130 135 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp

145 150 155 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
165 170 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
180 185 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
195 200 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
210 215 220

Tyr Asn Leu Ala Asp Leu Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225 230 235 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 60
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacteria

<220>
<221> CDS
<222> (1)..(753)

<223> Proteorhodopsin variant from pcr clone PalE1;GenBank# AF350001

<400> 60

```
atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca        48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt        96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt       144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act       192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg       240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gac act ggt gat acc cca aca gta ttc aga tat       288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa gtg gtt gag ttc tat cta       336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Val Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt       384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125
```

```
cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta tat atg ggt gaa ggc aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac cct gca tac aac gca atg atg atg      576
Ser Thr Ala Ser Pro Ala Val Asn Pro Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg ggt ggc gaa ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 61

<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacteria

<400> 61

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1 5 10 15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
85 90 95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Val Val Glu Phe Tyr Leu
100 105 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu

115 120 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
130 135 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145 150 155 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
165 170 175

Ser Thr Ala Ser Pro Ala Val Asn Pro Ala Tyr Asn Ala Met Met Met
180 185 190

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
195 200 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
210 215 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225 230 235 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 62
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PalE6; GenBank#AF350002

<400> 62

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atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca        48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                  10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt        96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gta ttc ttt       144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act       192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60

gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tac atg       240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat aca cca aca gta ttt aga tat       288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95
```

```
att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta      336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt      384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct      432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

ggt tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg      480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

tta tac atg att tat gag cta cat atg ggt gaa ggt aag gct gct gta      528
Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg aag      576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

att att gtt att gga tgg gca att tat cct gct gga tat gct gct ggt      624
Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

tac cta atg agt ggt gac ggt gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
```

225 230 235 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct 753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250

<210> 63
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 63

Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1 5 10 15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
20 25 30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
35 40 45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
50 55 60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65 70 75 80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr

```
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu His Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Lys
            180                 185                 190

Ile Ile Val Ile Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
        195                 200                 205

Tyr Leu Met Ser Gly Asp Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220
```

```
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
```

<210> 64
<211> 753
<212> DNA
<213> Naturally occurring gamma proteobacterium

<220>
<221> CDS
<222> (1)..(753)
<223> Proteorhodopsin variant from pcr clone PalE7; GenBank# AF350003

<400> 64

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atg ggt aaa tta tta ctg ata tta ggt agt gct att gca ctt cca tca       48
Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

ttt gct gct gct ggt ggc gat cta gat ata agt gat act gtt ggt gtt       96
Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

tca ttc tgg ctg gtt aca gct ggt atg tta gcg gca act gtg ttc ttt      144
Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

ttt gta gaa aga gac caa gtc agc gct aag tgg aaa act tca ctt act      192
Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
    50                  55                  60
```

```
gta tct ggt tta att act ggt ata gct ttt tgg cat tat ctc tat atg        240
Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

aga ggt gtt tgg ata gat act ggt gat acc cca aca gta ttc aga tat        288
Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

att gat tgg tta tta act gtt cca tta caa atg gtt gag ttc tat cta        336
Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

att ctt gct gct tgt aca agt gtt gct gct tca tta ttt aag aag ctt        384
Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

cta gct ggt tca tta gta atg tta ggt gct gga ttt gca ggc gaa gct        432
Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

gga tta gct cct gta tta cct gct ttc att att ggt atg gct gga tgg        480
Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

cta tac atg att tat gag cta tat atg ggt gaa ggt aag gct gct gta        528
Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

agt act gca agt cct gct gtt aac tct gca tac aac gca atg atg atg        576
Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190

att att gtt gtt gga tgg gca att tat cct gct gga tat gct gct ggt        624
Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
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        195                 200                 205

tac cta atg ggt ggc gaa ggc gta tac gct tca aac tta aac ctt ata      672
Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
    210                 215                 220

tat aac ctt gct gac ttt gtt aac aag att cta ttt ggt ttg atc att      720
Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225                 230                 235                 240

tgg aat gtt gct gtt aaa gaa tct tct aat gct                          753
Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
                245                 250
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<210> 65
<211> 251
<212> PRT
<213> Naturally occurring gamma proteobacterium

<400> 65

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Met Gly Lys Leu Leu Leu Ile Leu Gly Ser Ala Ile Ala Leu Pro Ser
1               5                   10                  15

Phe Ala Ala Ala Gly Gly Asp Leu Asp Ile Ser Asp Thr Val Gly Val
            20                  25                  30

Ser Phe Trp Leu Val Thr Ala Gly Met Leu Ala Ala Thr Val Phe Phe
        35                  40                  45

Phe Val Glu Arg Asp Gln Val Ser Ala Lys Trp Lys Thr Ser Leu Thr
```

```
    50                  55                  60

Val Ser Gly Leu Ile Thr Gly Ile Ala Phe Trp His Tyr Leu Tyr Met
65                  70                  75                  80

Arg Gly Val Trp Ile Asp Thr Gly Asp Thr Pro Thr Val Phe Arg Tyr
                85                  90                  95

Ile Asp Trp Leu Leu Thr Val Pro Leu Gln Met Val Glu Phe Tyr Leu
            100                 105                 110

Ile Leu Ala Ala Cys Thr Ser Val Ala Ala Ser Leu Phe Lys Lys Leu
        115                 120                 125

Leu Ala Gly Ser Leu Val Met Leu Gly Ala Gly Phe Ala Gly Glu Ala
    130                 135                 140

Gly Leu Ala Pro Val Leu Pro Ala Phe Ile Ile Gly Met Ala Gly Trp
145                 150                 155                 160

Leu Tyr Met Ile Tyr Glu Leu Tyr Met Gly Glu Gly Lys Ala Ala Val
                165                 170                 175

Ser Thr Ala Ser Pro Ala Val Asn Ser Ala Tyr Asn Ala Met Met Met
            180                 185                 190
```

Ile Ile Val Val Gly Trp Ala Ile Tyr Pro Ala Gly Tyr Ala Ala Gly
195 200 205

Tyr Leu Met Gly Gly Glu Gly Val Tyr Ala Ser Asn Leu Asn Leu Ile
210 215 220

Tyr Asn Leu Ala Asp Phe Val Asn Lys Ile Leu Phe Gly Leu Ile Ile
225 230 235 240

Trp Asn Val Ala Val Lys Glu Ser Ser Asn Ala
245 250